

Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554

In the Matter of )  
 )  
Amendment of Parts 2 and 15 of the )  
Commission's Rules to Deregulate the ) ET Docket No. 95-19  
Equipment Authorization Requirements )  
for Digital Devices )  
 )

To: The Commission

**INTEL PETITION FOR RECONSIDERATION**

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## **SUMMARY**

Intel supports the Commission's twin goals of streamlining the equipment authorization process and ensuring compliance with existing substantive emissions limitations. Intel submits this petition for reconsideration because it believes there are important additional steps that the Commission should take promptly to modify its equipment authorization rules to further those goals. In particular, the Commission should replace the "cover-off" testing rule with a rule permitting CPU boards to be authorized via cover-on testing in representative enclosures. If the Commission maintains the "cover-off" rule, it should increase the testing margins for frequencies above 216 MHz.

This proceeding has not established any need for more stringent substantive limitations on emissions, but that is precisely the effect of the current cover-off testing rule. While personal computer enclosures typically provide shielding well in excess of 12 dB, the Commission's rules do not permit a CPU board to be authorized if its emissions in a cover-off test exceed a 6 dB margin over the cover-on standards. Thus, a CPU board must pass a significantly more stringent test than a fully assembled computer. Moreover, cover-off testing imposes unnecessary additional costs on CPU board manufacturers and system integrators and is likely to become impossible in the near future as changes in computer technology lead to changes in enclosure design. In other words, the cover-off testing requirement has adverse effects on system integrators and consumers alike, with no corresponding benefits.

Because the cover-off rule is flawed, Intel proposes that the Commission permit CPU boards to be authorized through cover-on testing using representative enclosures. This approach is used for other computer components, including peripherals and power supplies, and also has

been adopted in Europe. It will avoid the problems created by the cover-off rule without creating any meaningful risk of increased emissions in the real world.

If the Commission chooses not to permit testing of CPU boards in representative enclosures, it must increase the margins for cover-off testing. As described above, the current limits for cover-off testing are more stringent than necessary in light of the actual shielding characteristics of PC enclosures. Consequently, the Commission can and should adjust the cover-off testing margins for frequencies above 216 MHz to account for the additional shielding that enclosures actually provide.

Finally, Intel recognizes that this pleading is only part of a broader dialogue in this proceeding between the Commission and the computer industry. Intel believes it is critical for the industry and the Commission to continue to work together.

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**INTEL PETITION FOR RECONSIDERATION**

Intel Corporation ("Intel"), by its attorneys, hereby submits this petition for reconsideration of the Commission's *Reconsideration Order* in the above-referenced proceeding.<sup>1/</sup> As shown below, the Commission should modify the rules adopted in the *Reconsideration Order* so that the so-called "cover-off" testing regime is not a requirement for central processing unit ("CPU") board authorization. At a minimum, the Commission must modify the testing margins of the present regime.

**I.     INTRODUCTION.**

In 1971, Intel created the world's first microprocessor and sparked the computer revolution. Intel soon became the leading manufacturer of personal computer ("PC") microprocessors. More recently, Intel has become the leading provider of CPU boards used by large and small PC manufacturers and system integrators. In this role, Intel has gained considerable experience in addressing radio frequency ("RF") emissions compliance issues.

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<sup>1/</sup>     *Amendment of Parts 2 and 15 of the Commission's Rules to Deregulate the Equipment Authorization Requirements for Digital Devices*, Memorandum Opinion and Order, ET Docket No. 95-19, FCC 97-240 (rel. July 18, 1997) (the "*Reconsideration Order*"). Intel also is seeking a postponement of the effective date of Section 15.32(a)(1) of the Commission's Rules, as described in its Request for Postponement of Effective Date of Rule filed on this date.

Intel's design, manufacturing, and sales of CPU boards are directly affected by the Commission's rules governing RF emissions and the procedures for ensuring compliance with those substantive requirements. For that reason, Intel has participated in this proceeding. Intel's objective is to ensure that the Commission's important emissions control and compliance goals are met without undue burdens on the computer industry or American PC users, either today or in light of anticipated technological developments.

Intel was one of many companies that supported, through industry associations, the amendment of Section 302 of the Communications Act to explicitly permit private compliance certification procedures.<sup>2/</sup> Congress' goal in giving the Commission the authority to permit private certification was to streamline the approval process, thereby reducing the market risks that result from regulatory delays.<sup>3/</sup> At the same time, both the Commission and Intel have recognized that any approval process must meet the baseline requirements of *maintaining emissions control and increasing the level of compliance* with the Commission's substantive limitations on interference from RF devices, including PCs. For that reason, in considering new rules or rule changes, the Commission should focus on mechanisms for making compliance easier without changing the Commission's longstanding emissions limits in real world situations and without increasing the risk that non-compliant PCs will be marketed or sold.

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<sup>2/</sup> The Commission relied in part on this authority in adopting the rules in this proceeding. *Amendment of Parts 2 and 15 of the Commission's Rules to Deregulate the Equipment Authorization Requirements for Digital Devices*, Report and Order, 11 FCC Rcd 17915, 17918 (1996) (the "Initial Order").

<sup>3/</sup> See generally Joint Explanatory Statement of the Committee of the Conference (H.R. Rep. No. 458, 104th Cong., 2d Sess.) at 1 (purpose of the Telecommunications Act of 1996 is "to provide for a pro-competitive, de-regulatory national policy framework designed to accelerate rapidly private sector deployment of advanced telecommunications and information technologies").

The rules adopted in this proceeding to date — including the decision in the *Reconsideration Order* to return the relative emissions threshold for the “cover-off” test to the 6 dB level proposed in the Notice of Proposed Rulemaking<sup>4/</sup> — are important steps to achieving the goals of Congress and the Commission. Nevertheless, Intel believes that the Commission can do more to increase compliance yet reduce the burdens of certification, consistent with the existing substantive emissions standards. As described in more detail below, the current cover-off testing rule has self-defeating limitations, and is impractical for many current and future PC designs.

For that reason, Intel proposes that the Commission adopt rules that permit CPU board manufacturers to certify CPU board compliance based on testing in a representative enclosure. This authorization test methodology is the basis for approving other PC component boards, some of which produce more RF emissions than CPU boards, and power supplies. It also is used successfully in Europe for CPU board authorization. If the Commission believes that additional safeguards are needed, Intel proposes a procedure that would facilitate compliance by system integrators.<sup>5/</sup>

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<sup>4/</sup> *Amendment of Parts 2 and 15 of the Commission’s Rules to Deregulate the Equipment Authorization Requirements for Digital Devices*, Notice of Proposed Rulemaking, 10 FCC Rcd 8345 (1995). Under the cover-off rule, a CPU board first is tested in an enclosure with the top and at least two sides removed. If the test results in emissions no more than 6 dB greater than the maximum permissible level, the CPU board then is tested with the cover on. If this second test shows emissions at permissible levels, the CPU board is deemed compliant. The second test is not required if the results of the cover-off test are within the Commission’s emission limits. 47 C.F.R. § 15.32(a)(1).

<sup>5/</sup> As described in detail in Appendix B, the FCC could permit CPU board manufacturers to test CPU boards in representative configurations and then specify mandatory configuration design attributes in the detailed instructions that accompany CPU boards and that are used by system integrators to assemble PCs.

Intel also recognizes that this pleading is only one part of the dialogue between the Commission and the personal computer industry in this proceeding. Intel hopes to continue to work with the Commission to resolve the issues described herein.

## **II. INTEL SUPPORTS THE COMMISSION'S PART 15 EMISSIONS CONTROL, COMPLIANCE, AND "MODULAR COMPUTER" GOALS.**

It is important to Intel to ensure that its PC microprocessors and CPU boards comply with the Commission's emission regulations. As the world's leading manufacturer of CPU boards, Intel maintains a policy of total compliance with the Commission's equipment authorization standards. Of course, Intel also is amply aware of the continuing convergence of computers with the communications devices the Commission's emission standards are intended and designed to protect. These devices include digital television tuners, wireless peripherals, and wireless PC communications systems. Intel has no incentive to manufacture components that would render inoperable these devices, many of which soon will be incorporated in PCs. Indeed, Intel rigorously follows strict internal guidelines for CPU board electromagnetic interference EMI layout and decoupling.<sup>6/</sup>

Moreover, because compliance with the Commission's emission standards is so critical, Intel is working hard to minimize emissions from future generations of CPU boards. Intel's current research and development efforts are focused on the following emissions control techniques:

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<sup>6/</sup> Intel's EMI guidelines for CPU board design are compiled in many internal reference documents. Three of the most important documents are "EMI Guidelines," which provides EMI direction to design engineers for board- and system-level products; "Motherboard EMI Layout Guidelines," which provides guidelines for minimizing EMI generation by using optimum layout techniques on new CPU board designs; and "Decoupling Guidelines," which describes optimizations to decoupling to reduce EMI and supply sufficient charge to decoupled devices. In addition, the design guidelines for each subsection of a CPU board contain information specific to that subsection that is pertinent to EMI reduction.

*Processor Shielding.* This technique shields microprocessor emissions by using a metallic insert that connects to the single edge contact cartridge ("SECC") substrate and SECC substrate heat plate to form a Faraday Cage. This form of processor shielding can provide up to 6 dB reduction in radiated emissions, but has significant limitations. Processor shielding adds manufacturing complexity and increases consumer costs by approximately two dollars for every CPU board.

*Spread Spectrum Clocking ("SSC").* SSC uniformly spreads the energy of clock harmonics over a wide spectral range by modulating the clock frequency. Intel plans on making this technology available in PCs in late 1998. SSC reduces radiated emissions from all clock-related sources by 6 to 12 dB. SSC imposes some technical limitations, such as decreasing system speed, and makes it difficult to use legacy peripheral devices. SSC will add about one dollar to the consumer cost of every CPU board.

*Multilayer CPU Boards.* CPU board radiation levels can be reduced by increasing the number of layers in the board from four to six. This enables clock signals to use strip-line routing, which radiates significantly less energy than the "microstrip" routing used on four layer boards. Multilayering could reduce radiated emissions by 10 to 15 dB, but is very expensive: up to 24 dollars per board for the PC consumer. As a result, multilayer desktop PC boards simply will not be competitive in the current marketplace.<sup>2/</sup>

Intel strongly supports the goals of the Commission's "modular computer" initiative. The modular computer concept is intended to make it easier for system integrators to comply with emissions standards and to reduce the number of PCs that do not comply with the procedural and substantive requirements of the Commission's rules. This petition is filed in furtherance of those goals because Intel believes that the Commission can take additional steps that will reduce the burdens on CPU board manufacturers and, thus, on system integrators while maintaining current emissions standards and increasing the level of actual compliance.

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<sup>2/</sup> Multilayer boards already are used in laptop and portable computers, which have more significant size constraints than desktop models. The higher cost of these boards contributes to the generally higher costs of laptop PCs.

**III. THERE IS NO NEED TO ADOPT MORE STRINGENT TESTING REQUIREMENTS THAN THOSE THAT WERE IN PLACE PRIOR TO THIS PROCEEDING.**

While Intel is dedicated to complying with the Commission's emission regulations, Intel is concerned that the new testing requirements would, in practice, make more stringent the current substantive emissions standards. Yet these more stringent standards were created without objective, technical evidence indicating that the standards were inadequate. For example, in its comments on Intel's Petition for Reconsideration, the National Association of Broadcasters ("NAB") simply stated that computers and other digital devices are a great source of interference to broadcast services.<sup>8/</sup> No systematized evidence was presented to support this conclusory statement even though such evidence, if it existed, would be easy to obtain. Moreover, PC emissions in most broadcast frequencies are particularly low, reducing the risk of interference even more. Absent a showing that the existing standards are inadequate, Intel believes that there is no need to make emissions limits more stringent for integrator-produced PCs. Therefore, it is unreasonable to burden the PC industry with demonstrating that the Commission's emission rules should not be more stringent; the burden instead should be placed upon the parties which claim a need for more stringent rules.

In this context, it is apparent that there is no need for more stringent substantive rules (and the Commission did not change the overall emission limits). In practice, however, the effect of the Commission's cover-off *testing* regime is to impose stricter *substantive* requirements on system integrators than on companies that test entire PCs.<sup>9/</sup> Because, as

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<sup>8/</sup> Comments of NAB, filed Oct. 31, 1996, at 2-4.

<sup>9/</sup> In general, the retail PC industry can be divided into two groups. Some companies design, manufacture, and test their own PCs. Because these companies sell many units of each model they manufacture, they can amortize the costs of complete system testing (continued...)

described below, the Commission's rules impose limits on cover-off emissions that are lower than necessary and because PC design does not always permit a manufacturer to comply with these overly stringent cover-off testing requirements, in practical terms the modular computer approach may not be available to PC integrators, defeating the whole purpose of the rules.

#### **IV. THE COMMISSION'S NEW "COVER-OFF" TESTING RULE IS FUNDAMENTALLY FLAWED.**

CPU board certification is intended as an alternative to traditional full-system RF emissions testing of PCs. In practice, however, the FCC's program for CPU board certification, specifically the "cover-off" testing rule,<sup>10/</sup> is not a practical option for CPU board manufacturers or system integrators. Cover-off testing imposes more stringent emissions limits than apply to full systems, increases costs for American consumers and businesses, and does not necessarily result in better compliance with the substantive requirements of the Commission's rules. Indeed, cover-off testing will not create any new flexibility for most system integrators.

Most importantly, as noted above, the flaws in the cover-off testing rule will produce unnecessary and burdensome costs for CPU board manufacturers attempting to certify CPU boards for use by system integrators. Section 15.32(a)(1) requires radiated emissions from the system under test under the cover-off testing rule to be no more than 6 dB above the limits specified in Section 15.109 for complete systems. Intel's test data indicate that enclosures

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(...continued)

over a large number of PC sales and are largely unaffected by the modular PC rules. Other, typically smaller companies purchase PC components from vendors and assemble those components into finished computers. These companies are system integrators. Some system integrators are large, but most are small businesses serving local communities.

<sup>10/</sup> As described above, the cover-off testing rule requires two separate tests. In the first test, with the top and two sides of the enclosure removed, emissions must be within 6 dB of the Commission's substantive limits. 47 C.F.R. § 15.32(a)(1); *see also supra* note 4.

provide much more than 6 dB of shielding; thus, this rule unnecessarily establishes a more stringent standard than existed previously. More specifically, Intel's tests on eight PC enclosures that are representative of those used by system integrators show that, for the nearly 40 frequencies with the highest cover-on emissions, over 90% of emissions at the measured frequencies above 216 MHz are attenuated by at least 12 dB.<sup>11/</sup>

To reiterate, because PC enclosures actually provide more protection than has been assumed by the Commission, the standard for authorization of digital devices using CPU boards authorized under the cover-off testing rule effectively has been raised. As noted above, there is no evidence to show that there is currently a significant EMI problem due to PCs operating in homes and businesses.<sup>12/</sup> For that matter, there is no evidence indicating that integrator-produced PCs or PCs that have not been certified cause any more interference than tested and certified PCs. As a result, a "problem" has been solved that never existed.

At the same time, the cover-off testing rule singles out CPU boards while allowing other PC component boards with equivalent or greater radiation to comply with less stringent standards. Indeed, the FCC's new rules *explicitly* permit other PC component boards to emit significantly more RF radiation than CPU boards.<sup>13/</sup> Intel recognizes that the Commission

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<sup>11/</sup> See Appendix A. To the extent the Commission believes additional testing is desirable, Intel would be willing to obtain even more comprehensive data.

<sup>12/</sup> Even to the limited extent that RF interference has been identified, there is no indication that it is related to PC manufacturers. The study submitted by NAB with its comments on Intel's petition for reconsideration was completed in 1987, before there was significant home PC penetration, so most of the interference identified in that study must have been caused by other consumer electronic devices or by other electrical appliances such as vacuum cleaners and blenders.

<sup>13/</sup> 47 C.F.R. § 15.32(a)(1)(i) ("Emissions greater than 6 dB that can be identified and documented to originate from a component(s) other than the CPU board being tested, may be dismissed.").

already has considered this concern, but the fact remains that other boards can have emissions greater than a typical CPU board.

While the cover-off testing rule will do little if anything to reduce PC emissions, it certainly will increase prices to consumers. In many cases, CPU board manufacturers will be required to incur additional engineering and material expenses, simply to get a CPU board to pass the cover-off test, even when the same CPU board would pass the traditional cover-on test easily and when there will be no meaningful effect on actual, real-world emissions. These extra costs will be passed on to system integrators and to PC buyers. This will be a significant — yet unnecessary — burden to American businesses and consumers. Moreover, for CPU boards under the cover-off limits, the new rules double the testing that must be undertaken to authorize CPU boards and, consequently, increase the costs of the boards themselves and the PCs that contain them. Again, this cost will have little or no impact on reducing the incidence of real world interference.

The delays and increased costs associated with the cover-off testing rule also will have significant adverse secondary effects. The cover-off testing rule likely will increase the time between introduction of new technologies and the availability of those technologies to system integrators who often are able to deploy the latest technology earlier than large end-product PC manufacturers. Thus, in a marketplace that puts a high value on the most current technology and depends on short time-to-market periods, the cover-off testing rule hurts U.S. integrators, as well as American PC buyers, who rely on integrators either directly or indirectly to keep PC prices as low as possible.

This competitive disadvantage will be magnified because, as noted before, other countries do not impose this additional testing requirement and only American consumers and businesses will incur increased costs. Indeed, the cover-off test for CPU boards is unique to the

FCC. A CPU board may be designated with the "CE" marking (and, thus, be sold in Europe) after passing only a regular cover-on system test and providing suitable installation instructions. Thus, a consumer in Paris will be able to purchase a PC with a CPU board that may be unavailable to a consumer in Chicago, solely because the FCC requires cover-off testing. The absence of international harmony on emissions testing can only result in the reduction of available high technology and increased U.S. consumer and business costs.

Cover-off testing also does not account for the realities of the computer industry. Indeed, the industry is best positioned to understand the precise relationships between noise sources and shielding. As described above, Intel and other CPU board manufacturers already have strong incentives to eliminate harmful interference and have every reason to comply with the Commission's regulations. Indeed, given the proliferation of computer peripherals that could be affected adversely by excessive emissions, the computer industry has much more to lose from harmful interference than it could possibly gain. Unfortunately, the cover-off testing rule does not allow the industry to address these issues; rather, it adopts a specific model that all must follow.

For example, the cover-off testing rule does not address CPU boards used to upgrade laptop computers or other PC products that cannot have a top and two sides open. Changes in PC design also will make cover-off testing impracticable for many PCs in the near future. CPU boards that rely on their enclosures to provide critical, sophisticated heat dissipation, in addition to emissions shielding, already are in final development. Very soon, because an air-ducting chassis will be required to prevent CPU overheating, taking the cover off many new PCs will be equivalent to snipping the power cord: The computer simply will not operate with the cover removed. When this happens, cover-off testing will be a difficult, if not entirely infeasible, option.

**V. THE COMMISSION SHOULD PERMIT CPU BOARD COMPLIANCE TESTING IN A REPRESENTATIVE CHASSIS ENCLOSURE WITH ITS COVER ON.**

Intel proposes that the Commission adopt rules that permit CPU board manufacturers to certify CPU board compliance based on testing in a representative enclosure.<sup>14/</sup> This authorization test methodology is the basis for approving other PC component boards, some of which produce more RF emissions than CPU boards, and power supplies. As noted above, it also is used successfully in Europe for CPU board authorization. This approach has worked satisfactorily before for other components and in other countries; there is no reason to believe it will not work equally well for CPU boards in the United States. The Commission can implement this approach by adapting the current language of Section 15.32(b), which applies to power supplies, or the rules for peripherals, Sections 15.101(d) and 15.31, to the testing of CPU boards.

If the Commission believes that additional safeguards are needed, Intel proposes that the agency adopt an additional procedure that would facilitate compliance by system integrators. One possibility, as described in detail in Appendix B, is that the FCC could permit CPU board manufacturers to test CPU boards in representative configurations and then, in addition, specify mandatory configuration design attributes in the detailed instructions that accompany all CPU boards and that are used by system integrators to assemble PCs. Intel and other parties in the industry would be happy to work with the Commission staff to develop these or other such supplemental procedures to replace the cover-off testing rule.

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<sup>14/</sup> Intel previously proposed an authorization program for enclosures that would have allowed combinations of CPU boards and enclosures based on the emissions and shielding characteristics of the respective components. Intel Petition for Reconsideration, filed July 19, 1996, at 4-6. Intel now agrees with the Commission that this earlier proposal would have been "too complex and unworkable." *Reconsideration Order* at ¶ 20. The approach proposed herein is different because it does not impose testing obligations on enclosure manufacturers and because it will reduce the compliance burdens on system integrators.

**VI. IF THE COMMISSION DOES NOT ELIMINATE THE COVER-OFF TESTING RULE, THE COVER-OFF EMISSION TESTING MARGIN MUST BE INCREASED AT SOME FREQUENCIES.**

As described above, the cover-off testing procedure effectively tightens radiation standards even though there is no evidence that such tightening is necessary or intended, and will result in unnecessary burdens to American consumers and businesses. Accordingly, if the Commission does not eliminate the cover-off testing rule, it must reevaluate the cover-on/cover-off testing margin.

As demonstrated above, the 6 dB margin adopted for the cover-off rule does not take into account the full shielding effect of computer enclosures.<sup>15/</sup> More specifically, Intel's tests on eight PC enclosures representative of those used by system integrators show that, for the 39 frequencies with highest cover-off emissions, over 90% of emissions at the measured frequencies above 216 MHz are attenuated by at least 12 dB.

In other words, the current rules would deny certification for CPU boards that, even in the worst case scenario, would produce emissions that are far below the current limits. Accordingly, if the cover-off testing rule must be maintained, Intel respectfully requests that the cover-off/cover-on test margins be reset as follows:

<b>Frequency Range</b>	<b>Change in Cover-Off / Cover-On Testing Margin</b>
30-88 MHz	No change (6 dB total margin)
88-216 MHz	No change (6 dB total margin)
216-960 MHz	Increased by 6 dB (12 dB total margin)
Above 960 MHz	Increased by 3 dB (9 dB total margin)

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<sup>15/</sup> See Section IV, *supra*, and Appendix A.

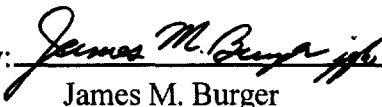
The proposed additional testing margins take into account not only the shielding effectiveness of enclosures used by integrators, but also contemplate expected advances in CPU and CPU board technology in the coming years. In other words, Intel believes that these modifications — again, to the testing rules, not the actual RF emission limits — will accommodate not only today's generation of CPU boards, but also those boards marketed in the foreseeable future using the advanced RF emissions control techniques described above. Of course, Intel requests only the bare minimum additional testing margin, and no increase in testing margin at frequencies below 216 MHz (which contain AM, FM, and VHF television broadcasting).

## VII. CONCLUSION

For all these reasons, Intel Corporation respectfully requests that the Commission reconsider the *Reconsideration Order* and modify its rules as proposed herein.

Respectfully submitted,

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## **APPENDIX A**

### **CASE ATTENUATION TEST RESULTS**

Intel performed tests on desktop chassis from various high volume manufacturers to determine the amount of attenuation a typical PC enclosure. Cases were purchased from local retail stores and drivers or filler were installed to fill up unused openings. A comb generator then was placed in the chassis with the cover off and a test scan was run from 30 MHz to 1 GHz. The cover then was replaced and the tests re-run. The following data show, for each of the highest cover-off readings, the frequency, the cover-off and cover-on measured radiation at those frequencies, and the difference between the two readings. As shown in the attached tables, over 90% of the test points show chassis attenuation of at least 12 dB, and none of the nearly 40 highest emission readings for any of the enclosures occurred at a frequency below 290 MHz.

Appendix A

Page 1

**Chenbro A6711-300**

Frequency (MHz)	Cover On to FCC Limits	Cover Off to FCC Limits	Shielding Effectiveness (dB)
301	2.6	-26.4	29
311	-0.3	-26.3	26
321	-4.8	-26.9	22.1
331	-6	-30.6	24.6
341	-2.7	-31.6	28.9
350	3.6	-31.3	34.9
360	4.5	-35.1	39.6
371	3.9	-37.7	41.6
381	2.2	-37.5	39.7
391	-2.2	-36.8	34.6
401	-4.3	-35.9	31.6
411	-2.5	-36.3	33.8
421	-2.7	-33.9	31.2
431	-3.1	-32.3	29.2
440	-0.8	-31.3	30.5
451	-1.3	-32.2	30.9
461	-3.2	-29.7	26.5
471	-3.4	-28.8	25.4
481	1.3	-28.5	29.8
491	0.6	-30.7	31.3
501	0.9	-32.1	33
511	4.4	-31.8	36.2
541	3.8	-32.5	36.3
551	-0.9	-23.5	22.6
561	2.3	-32	34.3
600	4.6	-29.9	34.5
610	2.1	-30.1	32.2
620	0.1	-29.1	29.2
630	1.9	-28.6	30.5
641	5.1	-28	33.1
741	4.5	-22	26.5
751	5.3	-22	27.3
931	0	-20	20
941	-3.7	-21	17.3
951	-1.4	-23	21.6
961	-2	-24	22
971	-1.7	-23.5	21.8
981	-1.9	-25	23.1
991	-3.2	-25	21.8

**Enlight EN-7230**

Frequency (MHz)	Cover On to FCC Limits	Cover Off to FCC Limits	Shielding Effectiveness (dB)
381	-14.6	-36.4	22
391	-15	-36	21
401	-14.8	-37.9	23.3
411	-16.7	-38.7	22
421	16.8	-38.4	21.6
431	-15	-33.9	19.1
440	-18.1	-33	14.9
451	-15.1	-33.8	18.7
461	-12.5	-34	21.5
471	-11.5	-33.1	21.6
481	-12.6	-34.5	21.9
491	-14.4	-35.2	20.9
501	-13.8	-34.5	20.8
511	-13	-31.1	18.4
521	-12.2	-32.4	20.2
531	-11.2	-33.9	22.7
541	-10.8	-32.8	22
551	-11.2	-33.5	22.3
561	-10.7	-32.9	22.2
571	-11.4	-32	20.6
581	-16.1	-32.4	16.3
591	-12.9	-31	18.1
601	-11.8	-29.1	17.3
611	-13.7	-29.6	16
621	-12.9	-29.6	16.7
631	-13.5	-29.6	16.6
641	-15.9	-30.8	15.7
651	-9.8	-29.8	20
661	-14.3	-29.5	15.7
671	-15.1	-28.6	13.6
681	-13.6	-28.4	14.9
691	-8.5	-27.4	18.9
852	-9	-19.5	10.5
862	-9	-19.4	10.4
872	-10.1	-18.8	8.7
882	-10	-18	8
892	-10.2	-20.5	10.3
902	-9.3	-20.5	11.2
912	-7.7	-21	13.3

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Frequency (MHz)	Cover On to FCC Limits	Cover Off to FCC Limits	Shielding Effectiveness (dB)
381	-0.1	-35.6	35.5
391	-0.9	-35.9	35
401	-2.5	-36.2	33.7
411	-5.1	-37.2	32.1
421	-8.1	-36.2	28.1
431	-3.8	-35.7	31.9
440	-5.5	-36.1	30.6
451	-8.7	-37.3	28.6
461	-9.7	-35.9	26.2
471	-13.8	-32.9	19.1
481	-12.1	-32.4	20.3
491	-12.6	-33.2	20.6
501	-15.5	-34.4	18.9
511	-17	-32.7	15.7
520	-18	-32.8	14.8
531	-18.5	-34.2	15.7
541	-18.2	-33.7	15.5
551	-17.4	-32.9	15.5
561	-15	-31.7	16.7
571	-12.4	-31.5	19.1
581	-11.3	-32.1	20.8
591	-9.8	-31.5	21.7
601	-8.2	-30.4	22.2
611	-6.4	-31.2	24.8
621	-5.3	-31.4	26.1
631	-5	-31.3	26.3
641	-5.8	-30.2	24.4
651	-8.9	-29.8	20.9
661	-7.9	-29	21.1
671	-4.9	-27.2	22.3
681	-1.6	-27.1	25.5
761	-0.2	-20	19.8
772	-2.4	-22	19.6
852	-0.7	-20	19.3
871	0.6	-17	17.6
942	0.4	-25.5	25.9
952	-5	-26	21
981	-1	-19	18
991	-0.5	-18	17.5

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Frequency (MHz)	Cover On to FCC Limits	Cover Off to FCC Limits	Shielding Effectiveness (dB)
321	-12.3	-31.6	19.3
331	-21	-36.5	15.5
340	-13.2	-36.8	23.6
350	-10.8	-35.1	24.3
360	-10.3	-35.6	25.3
371	-13.2	-34.1	20.9
381	-15.5	-36.5	21
391	-16.9	-35.5	18.6
401	-16.6	-34.6	18
411	-19.7	-34.2	14.5
421	-16.3	-32.3	16
431	-16.6	-29.7	13.1
440	-18	-33.7	15.7
451	-16.5	-35.7	19.2
461	-18.8	-35.1	16.3
471	-16.3	-35.8	19.5
481	-15.5	-37.1	21.6
491	-12.5	-37.2	24.7
501	-12.5	-36.9	24.4
511	-14.6	-33.9	19.3
520	-16.1	-30.1	14
531	-12.4	-32.2	19.8
541	-10.7	-32.1	21.4
551	-13.6	-32.4	18.8
561	-12.8	-32.4	19.6
571	-10.6	-30.8	20.2
581	-11	-31.7	20.7
591	-10.8	-30.7	19.9
601	-9.4	-30.1	20.7
610	-9.1	-30	20.9
621	-10.6	-29.7	19.1
631	-10.2	-30.7	20.5
641	-8.6	-30.1	21.5
781	-10.4	-20.7	10.3
792	-11.2	-19.1	7.9
802	-10.2	-17.5	7.3
891	-9.3	-17	7.7
901	-9.6	-17	7.4
941	-8.7	-20.3	11.6

Appendix A  
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Star ATX

Frequency (MHz)	Cover On to FCC Limits	Cover Off to FCC Limits	Shielding Effectiveness (dB)
350	-1.7	-30.4	28.7
360	-8	-32.1	24.6
371	-13.3	-37.4	24.1
381	-12.2	-34.7	22.5
391	-11.1	-33.8	23
401	-9	-38.4	29.4
411	-12.6	-36.2	23.6
421	-9	-33	24.4
430	-12	-34.6	23.5
440	-5.8	-35.7	29.9
451	-8.6	-31.2	22.8
461	-10.8	-38.6	28
471	-9	-34.7	25.7
481	-7.3	-33.8	26.5
491	-6.3	-35.4	29.1
501	-4.7	-35.3	30.6
511	-4.6	-32.1	27.5
520	-4.7	-30.7	26
531	-4.4	-34	29.6
541	-5.1	-33.8	28.7
551	-5.7	-32.1	26.4
561	-6.5	-32.5	26
571	-4.8	-31.7	26.9
581	-4.5	-32.4	27.9
591	-6.4	-31.6	25.2
600	-7.5	-36.8	29.4
610	-4.6	-30.9	26.3
620	-8.4	-35.8	27.8
630	-12	-34.7	22.7
641	-10.6	-34	25
651	-7.3	-31.1	23.8
661	-5.2	-28.5	23.3
671	-7.4	-30.3	23
681	-8	-36.5	28.5
691	-5.3	-28.3	23
701	-4	-26.5	22.5
711	-3.9	-26	22.1
721	-2.8	-26	23.2
731	-2	25.5	23.5

**Bermo NLX**

Frequency (MHz)	Cover On to FCC Limits	Cover Off to FCC Limits	Shielding Effectiveness (dB)
330	-4.7	-16	11.3
340	-4.6	-16	11.4
350	-6	-16	10
360	-9.9	-26	16.4
371	-12.8	-30.3	17.5
381	-6.4	-30.7	24.3
401	-4.9	-16	11.1
411	-10.3	-24.2	13.9
421	-6.4	-28.5	22.1
431	-8.9	-31.4	23.1
441	-5.6	-31	25.4
452	-7.4	-30.7	23.3
461	-10.7	-29	18.6
471	-9.6	-26.1	16.6
481	-3.6	-24.1	20.5
501	-3.9	-25.5	21.6
511	-3.3	-28.3	25
581	-7.3	-25.5	18.2
591	-7.4	-26.5	19.1
600	-3.5	-26.9	23.4
610	-5.6	-26	20.4
621	-10.4	-24.5	14.2
631	-13.2	-23	9.8
641	-9.5	-20	11
661	-10.3	-26.2	16.1
671	-12.9	-26.4	13.5
681	-12.1	-25.6	13.5
691	-11.2	-26.5	15.5
701	-9	-22	13.1
761	-3.5	-19	15.5
812	-8	-22	14
822	-10.1	-21	11.1
832	-8.3	-23	14.7
842	-6.5	-23.5	17
892	-11.8	-24.4	13.2
902	-11.9	-24.8	13
912	-11	-24.9	14.2
922	-7.8	-24.2	16.4
932	-4.6	-22	17.4